THE NATURE CONSERVANCY NEWS

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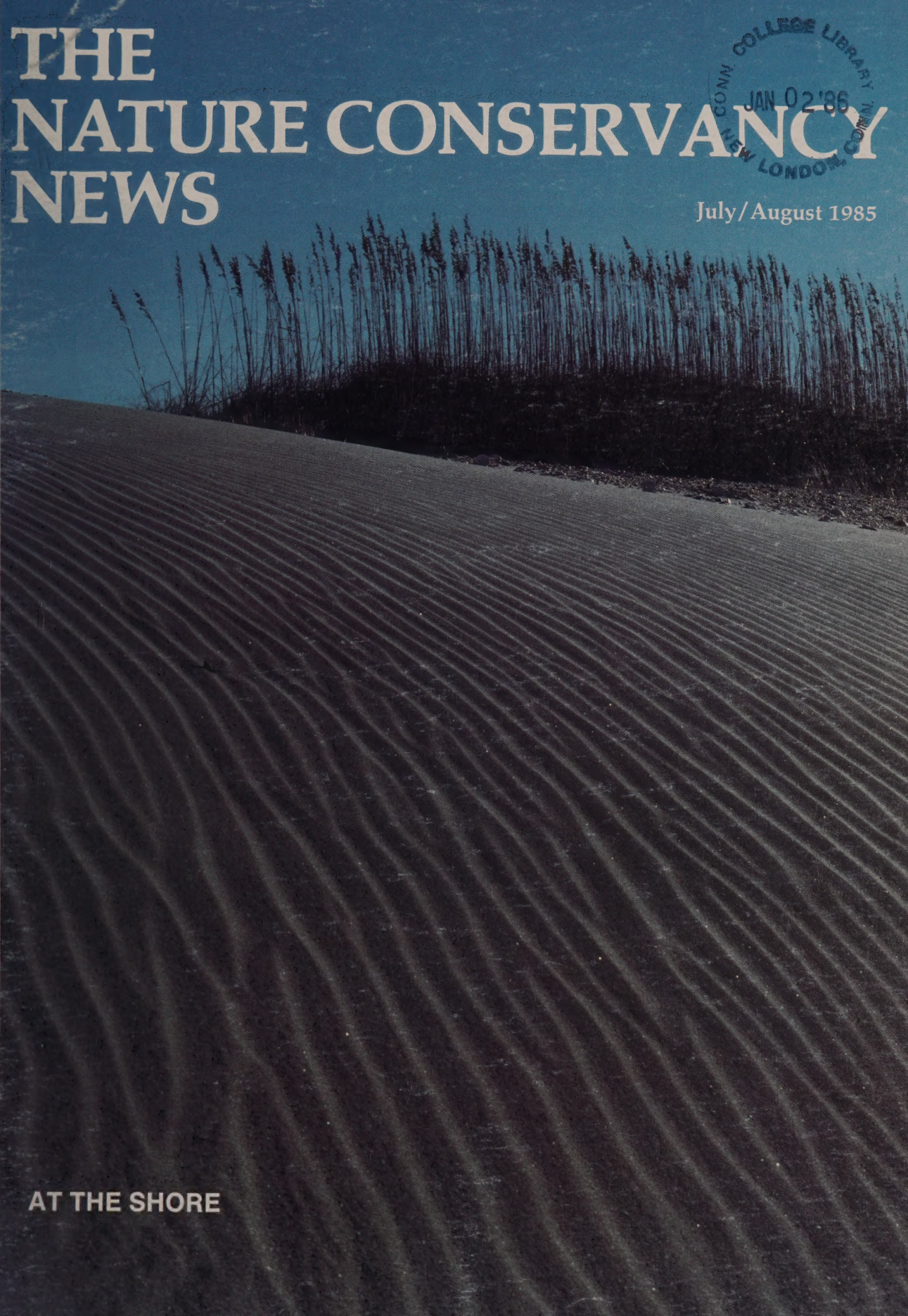

AT THE SHORE

Gary Meszaros

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JULY/AUGUST 1985

THE NATURE CONSERVANCY NEWS

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COVER: Furrowed dune and sea oats on North Carolina's Outer Banks. Photo by Glenn Van Nimwegen.

The Nature Conservancy is a national conservation organization committed to the preservation of natural diversity by protecting lands and waters supporting the best examples of all elements of our natural world.

To date the Conservancy and its members have been responsible for the preservation of 2,438,099 acres of forests, marshes, prairies, mountains, deserts, and islands: home to rare and endangered species of wildlife and plants. 3,778 projects have been completed since the acquisition of the first preserve in 1954. Approximately 60% of all preserves are retained by the Conservancy and managed by staff and volunteer land stewards.

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The Nature Conservancy

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Native Shores

EVERY SUNDAY of my childhood there was a struggle between my scientific father and my religious mother for the souls of their three sons. The prizes, and sometimes the battlefields, were barrier island beaches not far from our home on Long Island. My mother always managed to get her sons to church on major holy days, but sometimes she won other Sundays as well when my father wanted to go fishing by himself or with his friends. Or sometimes he was simply weary of the weekly struggle. He felt Sundays were too sacred to be spent in church. I can still see him striding across the sand into the full force of a northeaster with rain streaming from his hat, mustache, and rain-sodden overcoat, sermonizing that if there were a God Almighty, He was most likely to be found on a wave-pummeled beach.

Then, as now, my favorite season at the beach was the late winter or early spring when sea temperatures are warm enough to stimulate many fishes and the birds that prey upon them, yet still cool enough to discourage swimmers and less dedicated beachcombers. At this time of year, Jones Beach and Fire Island were my father's frequent destinations. From the deserted parking lot at Gilgo, we used binoculars to scan the panorama of bay and marshes for flighting waterfowl before crossing the highway and dunes to patrol the ever-changing strand.

One Sunday we'd see a few common loons beginning to show their nuptial plumage beyond rafts of white-winged scoters, old squaw, and other sea ducks. The next Sunday, not a single loon or sea duck remained, but the beaches were busy with

Sue Dodge

by George Reiger

thousands of restless shorebirds on their way to the sub-Arctic to breed. By September, many would be back in Latin America.

Almost every visit would result in the discovery of some boyhood treasure. My brothers and I would race ahead of my father, certain of finding something and eager to be the first to stake a claim. Barnacle-encrusted fishing floats or lost fishing lures were precious plunder, as were colorful glass bottles in that pre-plastic era. A dead seabird might become a show-and-tell item for Monday morning school, and we always harbored fantasies of finding a lump of ambergris—a kind of waxy bile secreted by sickly sperm whales that was once highly valued as a fixative in perfumery. One Sunday we found, instead, a whale.

I was awed by leviathan and angered when other people came and tried to rend it with wisecracks. As a naturalist, I know today that finbacks are possibly the most common whale in the northwestern Atlantic as well as the second largest of the whale species, after the blue. Finbacks also occasionally give birth in the New York Bight. A certain percentage of these young whales get separated from their mothers and may strand, or the mothers may strand first while looking for their 17-foot-long babies. However, all this more recently acquired knowledge in no way diminishes the retrospective wonder of seeing that first mysterious hulk pulsing in the surf.

Was it still alive? Where had it come from? Was this the God Almighty my father had promised we would one day find on a wave-pummeled beach?

Robert Noonan

The mating of horseshoe crabs is good news for hungry shorebirds: each May, thousands make precisely scheduled stops on East Coast beaches to feed on crab eggs.

BY THE TIME most people began visiting the shore in late spring, my family had retreated aboard a boat where, anchored in an inlet or bay, we enjoyed the beaches without having to mingle with the crowds. Because most New Yorkers like to vacation northward into New England during the summer months, my father did the opposite, heading south instead to explore the coast by boat as far as the then tiny resort of Ocean City, Maryland. While he trolled offshore for white marlin and bluefin tuna, his sons were left ashore to fish around dock pilings for small sea bass, puffers, and eels and to survey nearby beaches that teemed with nesting sea birds.

Each spring—in greatest concentrations between Long Island and Virginia's barrier beaches—horseshoe crabs creep ashore in countless millions to spawn. Clouds of semipalmated sandpipers, sanderlings, red knots, and ruddy turnstones in breeding plumage swarm about the crabs to feed on their eggs. It was difficult for us youngsters to comprehend such an immense diversity of life.

My father told us that just as the shorebirds had evolved migration patterns coinciding with the annual appearance of spawning horseshoe crabs, so sea turtles had evolved comparable patterns to take advantage of the spring concentration of adult crabs. (Sharks, in turn, migrate to feast on the aggregations of turtles.)

Not many Julys ago, Barry Truitt (manager of The Nature Conservancy's Virginia Coast Reserve) and I were anchored in an inlet of the Virginia barrier island chain. Suddenly, we heard the explosive gasp of a respiring sea turtle and saw an enormous loggerhead clutching a horseshoe crab in its huge parrot-like beak. The turtle crushed the crab and disappeared with its prey beneath the water's surface.

Although loggerhead turtles occasionally crawl ashore onto one of the Virginia barrier islands, this coast is on the extreme northern edge of the species' nesting range. The National Marine Fisheries Service, the U.S. Fish and Wildlife Service, and the National Park Service have tried, but failed, to establish a nesting colony on Assateague Island. There are no confirmed records of successful loggerhead spawning anywhere north of the Chesapeake Bay. Yet one day, while flying over the barrier islands looking for stranded marine mammals, I saw and photographed a fresh sea turtle track on the northern end of the Conservancy's Parramore Island. The turtle had crawled into beach grass, apparently dug a nest, and retreated to the sea on a parallel track still evident above the rising tide.

Still, each summer—from mid-May into October—sea turtles can be found resting and breathing at the surface of the sea just off the Virginia Coast Reserve. Some days, on offshore fishing trips, I will see a dozen or more, including a rare leatherback. One year I kept a careful tally of turtle sightings for the National Marine Fisheries Service. However, after the last of my completed turtle-watching forms was mailed to Washington, with no new forms sent in exchange, I gave up precise record keeping. Now I only steer out of my course to show a resting turtle to someone who does not get offshore as much as I do.

THIRTY YEARS AGO, when I was a teenager in Long Island and Florida, my brothers and I hardly bothered to distinguish shark species. Any big shark caught inshore along the Florida coast was a "bull," and any shark caught off the Long Island and New Jersey beaches was a "sand shark." I now know that each of these names was a catch-all for up to half a dozen different species.

Sharks were strange and sometimes loathsome creatures that self-respecting anglers avoided at all cost. They "stole" proper gamefish off our lines. One even tore out the bottom of a bag full of ground-up fish we were using as bait to attract bluefish. We thought hammerheads were particularly hideous, and only gradually did some of us come to see them with an admiration worthy of aeronautical engineers. Those wing-shaped heads with large eyes at either end are like jet fighters with fuel pods on the tips of their wings: the pods enable the aircraft to reduce cross-current drag when making tight turns.

All manner of sharks—from hammerheads, tigers, and makos to sandbars, lemons, and blacktips—are found in the vicinity of the Virginia Coast Reserve. As a matter of fact, although these 14 barrier islands are best known as important breeding grounds for myriad species of gulls, terns, skimmers, and wading birds, the islands' drains and bays are equally significant as spawning and nursery sites for fishes ranging in size from little *Fundulus* minnows to sofa-sized sandbar sharks.

Jack Casey, who today heads the National Marine Fisheries Service's research facility at Narragansett, Rhode Island, developed an abiding affection for Virginia's barriers islands while tagging hundreds of sharks there in the 1960s. Some of the sandbar sharks he and his graduate students tagged two decades ago are still turning up, including a female that was at liberty for 17 years before being recaptured off Campeche, Mexico.

Thanks to another study of sharks caught mostly around the Virginia Coast Reserve, ichthyologists Jack Musick and William Raschi recently completed a report for the National Aeronautics and Space Administration on the "Hydrodynamic Aspects of Shark Scales." Their paper explains how the longitudinally arranged V-shaped grooves in the denticles (tiny cone-shaped structures) on the skin of certain sharks reduce drag. The 3-M Corporation hopes to develop an adhesive tape duplicating the fishes' denticle design. The tape will be applied to the fuselage of aircraft, thereby saving the aviation industry millions of dollars a year in fuel costs.

The Virginia Coast Reserve is a cornucopia of natural wonders and potentials for scientific research. Its possible contributions to mankind lie beyond most imaginations; but in recognition of this wilderness along an otherwise too well-settled Atlantic Coast, the United Nations declared The Nature Conservancy's coastal preserve to be part of its worldwide network of specially designated "biosphere reserves."

THE INK WAS STILL WET on my farm's mortgage in 1970 when a consortium of bankers and real estate promoters announced they were going to turn the nearby islands of Virginia's Eastern Shore into a chain of highly developed resorts. Cedar Island was already subdivided, and its promoters—having renamed the island "Ocean City"—were trying to obtain a large federal subsidy

Ken Taylor

The loggerhead sea turtle, stunning and ponderous visitor to our native shores. One of this embattled migrant's major nesting concentrations is on the U.S. coast from North Carolina to Florida.

A COASTAL BARRIER SYSTEM

IN 1982, the U.S. Congress took an important step toward protecting portions of our coast by enacting the Coastal Barrier Resources Act (CBRA). The act established the Coastal Barrier Resources System (CBRS), a network of 186 undeveloped and unprotected barrier islands covering 751 miles of shoreline along the Atlantic and Gulf Coasts. The barrier islands and beaches included in the system can no longer receive federal financial assistance for such things as flood insurance or road and bridge building. While the act does not prohibit development, it does remove the incentives for developing that federal subsidies provide. It is a recognition that taxpayers should not pay for the benefits of a few or for the associated high risks incurred by those who choose to build on these fragile lands. Section 10 of the act also requires that a report be prepared examining the steps that can be taken by federal, state, and local governments—as well as private groups—to further protect coastal barrier islands. In addition, the U.S. Department of the Interior has completed a study identifying another 4,488 miles of shoreline for eventual addition to the Coastal Barrier Resources System.

Nonetheless, widespread development of our coastlines continues. In 1980, a U.S. Geological Survey report by Harry F. Lins examined and compared the trends in land use on 189 barrier islands along the Atlantic and Gulf Coasts over the time periods 1945 to 1955 and 1972 to 1975. During the latter period, development had increased dramatically: nearly 140,000 acres of these islands were lost; associated wetlands were also destroyed. Nor is there evidence that these trends have reversed in recent years. Developers who don't need federal help or subsidized insurance continue to build on many barrier beaches, despite the unstable and unpredictable nature of these coastal lands and the fact that efforts to stabilize them for development largely have been futile.

Lars Carlson
Department of Botany
University of Massachusetts-Amherst

for a bridge linking the island across the marshes to the mainland. Another company purchased Smith Island near the tip of the Delmarva Peninsula and began making the same appeals for public bridge-building funds.

Since most people don't like to live anywhere they can't reach by automobile, the consortium's request for bridge-building money became the conservationists' first line of defense against development. A bridge or causeway would degrade the marshes over which the structure was built. In addition, it might impinge even more adversely on the always uncertain dynamics of tidal flow and barrier island movement than the local extension of the Intracoastal Waterway had done in the 1950s. (See this issue's "Ecology Forum" on barrier island dynamics.)

In essence, the Virginia barrier islands were saved by using a stick and a carrot. The stick was the conservationists' argument that this kind of bridge-building was a public extravagance for the privileged few, who would next demand publicly funded water lines, sewage plants, floodplain insurance, and—finally—rescue by the Coast Guard, Red Cross, and Congress when storms inevitably washed away their alleged "improvements."

The carrot was The Nature Conservancy's willingness to buy out the speculators' interest in the islands, an interest that was no longer likely to yield abundant profits. As a nonprofit, nongovernmental organization, the Conservancy did not have to delay or justify its activities to anyone beyond a then relatively small and entirely sympathetic membership. It had only to raise the money for acquisition—in this case, funds were provided by the Mary Flagler Cary Charitable Trust—and persuade the developers to sell their attractive nuisances.

Susan Bournique

Seaside nursery: plover chick on Cobb Island in the Conservancy's 35,000-acre Virginia Coast Reserve.

Glenn Van Nimwegen

Marshland sunrise, Virginia Coast Reserve. The 14-island sanctuary has won recognition from the United Nations as an international biosphere reserve.

WHEN I WAS A TEENAGER, I joined the perennial lines of young people who stroll the beaches in search of "dream mates." Perhaps because the sighing sea induces immature minds to anticipate too much, we usually passed one another by, dazzled and blinded by sunlight scintillating from the sea.

Older people expect less and, therefore, receive more from their visits to a beach. An unbroken whelk shell becomes a pleasant find, a stranded sea creature, an epiphany. Some discoveries can lead to interesting artifact collecting. One friend found a beautiful stone ax in the hollow left by an overturned red cedar after a northeaster worked over Cedar Island. Another discovered the skull of an extinct giant beaver washed out of the sod on the southern end of Metompkin Island after a summer storm.

My most interesting find occurred in the marshes behind Wachapreague Inlet where a "something" stuck up like the broken base of a fossilized tree. I began to dig, convinced that the leg bone fragment—as I soon perceived it to be—would only turn out to be from a horse or cow. Still I gave it to friends at the Smithsonian Institution. They identified the bone, preserved it, and returned it to me since the museum already had ample mammoth and/or mastodon skeletal remains for reference and research. (The bone fragment was too small to determine exactly which.)

Regardless of the reason we give for visiting a beach—beachcombing, swimming, sunning, surfing, birding, or just random wandering—we are really there to feel the planet's pulse. Waves rushing up the strand are heartbeats, and the twice-daily cycle of tides is the Earth's respiring.

Along the mid-Atlantic Coast, tides move with an erratic energy comparable to the lives of the many millions of people inhabiting this diversified region. Although computerized tide tables predict each pulse, they regularly submit to the eccentric demand of winter winds and summer storms that add or subtract an hour here or a fathom there to previously scheduled turnings of the tide. One of the immense satisfactions of being near the sea is its constant reminder that man's laws are nothing when compared to nature's.

George Reiger's most recent books are *The Southeast Coast* and *Wanderer on My Native Shore.* The latter was a Pulitzer Prize nominee. A resident of Virginia's Eastern Shore, he has served as the Washington editor of *Audubon, National Wildlife,* and *International Wildlife.* Mr. Reiger has also been the conservation editor of *Field & Stream* for more than a dozen years.

Bruce Sorrie

Bruce Sorrie

Larry Morse

The plants of New England's sandplain grasslands (above), a globally endangered coastal community, occur nowhere else on Earth. The Conservancy has saved two of the four confirmed sites for sandplain gerardia (at left) and six for bushy rockrose (above)—including Katama Plains on Martha's Vineyard, focus of an ambitious $200,000 campaign.

Racing to Save the Coastal Heaths

by Paul Jeffrey Godfrey and Peter Alpert

MOORS AND HEATHLANDS: the words conjure up a treeless, timeless landscape, rolling away into misty distances. Treeless they are; timeless they are not. Outside of literature, heathlands—named for the diverse plants they support (the "heath" or *Ericaceae* family)—are under siege. Although some of the best of these habitats, famous in song and story, occur on the sea coasts of Britain and northern Europe, our nation's heathlands are in trouble. In North America, coastal heathlands are found in the Northeast, and comparable shrublands and grasslands occur on the West Coast.

Unfortunately, a combination of natural processes and the effects of recreation and development are bringing about the rapid disappearance of these shoreline plant communities.

Coastal heathland vegetation of the U.S. grows along the shores of Maine, on Cape Cod and the islands of southern New England, on eastern Long Island and Fire Island, and in northern New Jersey. The most extensive are on Massachusetts's Nantucket Island. Glacially deposited uplands and stable dunes are the usual sites. Here, the plants form a dense, tundra-like mat of low creeping shrubs—a growth habit due, in part, to the effects of salt spray, which tends to kill tall plants but spare low ones. The heath's more common plant species are bearberry, beach heather, black huckleberry, wintergreen, trailing arbutus, chokeberry, and several grasses—little bluestem, hairgrass, and poverty grass.

Along the Pacific Coast, from northern California to Washington, is another vegetational mosaic of grassland, shrub, and forest. As in New England, the shrubland of the Northwest coast contains members of the heath family, exemplified by dense thickets of salal and California huckleberry. In Oregon, it is the native grasslands that have nearly vanished. At their best, these remaining prairies are soft, lush swards of fine-leaved grasses and wildflowers. A key indicator of good sites is an abundance of red fescue, a delicate grass with silky russet heads.

MOST OF THE LARGE shoreline areas in the U.S. that are currently protected or legally regulated encompass beaches and wetlands. With a few exceptions, the majority of our coastal heathland and grassland communities are not included in these sites. In the New England region, the Nantucket Conservation Foundation has made great strides in preserving the heathlands on Nantucket Island. The Nature Conservancy also is helping to protect a grassland at Dickens/Lewis Farm on Block Island, Rhode Island, and a portion of Katama Plains on Martha's Vineyard. Katama supports a very rare type of shoreline heathland—the globally threatened coastal sandplain grassland. Of the heathlands on Martha's Vineyard, the Trustees of Reservations own some, while the National Park Service oversees the largest remaining heathland on Cape Cod. Maine's Acadia National Park contains examples of the more northerly heathland types.

These Northeast heathlands contain unusual

plant species, some of them possible arctic-alpine relicts left over from the Ice Age. For example, bearberry, a circumpolar arctic species found in most eastern heathlands and some western ones, is a common plant of high western mountains and of the tundra of northern North America and Eurasia. It also occurs on exposed areas around the Great Lakes. Another, three-toothed cinquefoil, is common throughout the Arctic, and along the high Appalachian peaks. It grows down the Canada coast and into Maine, where it can be found on rocks just above the surf and on the mountain summits. It even grows at a few sites on Cape Cod.

But other coastal heathland species, especially those of the sandplain grasslands, are endemics—they can be found in no other natural environment and are increasingly threatened. Staff members of Conservancy- and state-operated natural heritage programs in Massachusetts, New York, and Rhode Island are seeking four of the rarest sandplain grassland species: bushy rockrose (*Helianthemum dumosum*), Nantucket shadbush (*Amelanchier nantucketensis*), and sandplain gerardia (*Agalinis acuta*), as well as the regal fritillary (a butterfly with the scientific name of *Speyeria idalia*). Only four confirmed sites exist for the sandplain gerardia. To date, the Conservancy has protected two Massachusetts sites for the gerardia, six areas for the bushy rockrose, and two properties harboring not only the regal fritillary but also two rare bird species (northern harriers and grasshopper sparrows).

Paul J. Godfrey

Three-toothed cinquefoil, at home in the Arctic, makes a surprise showing on coastal heaths in Maine and Cape Cod. A number of the Northeast's star heathland plants are Ice Age hold-overs.

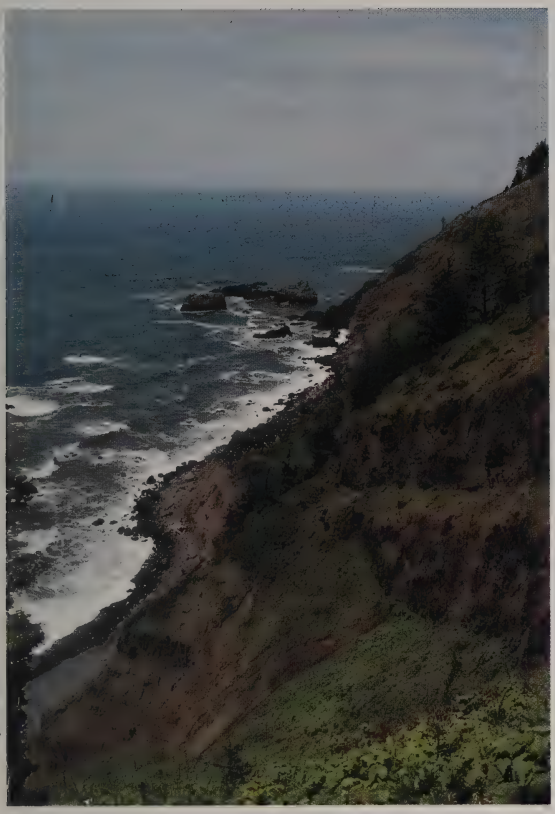
WHY ARE THESE SPECIES and their heathland habitats becoming so rare? Dr. Robert Zaremba, a Conservancy scientist who is one of the few U.S. authorities on rare and endangered heathland plants, believes that around the mid-1800s more than 100,000 acres of coastal heathland existed in southern New England and Long Island. (Interestingly, historical evidence suggests that the large size of these heathlands was partly the result of clearing, grazing, and fires following European settlement. How widespread they were prior to that time is not known.) Today, only an estimated 10,000 acres remain; about a third of this area is on Nantucket.

The chief long-term threat is ecological succession. Because a heathland is an early successional community—when natural processes such as fire have been eliminated—it is being invaded by larger shrubs and trees, like pitch pine and various oaks. Once the taller species grow above a heathland, most of the shorter plants die out because of shading and other forms of environmental competition.

Another, less significant threat is natural coastal erosion. The upland sites are being chipped away inexorably by ocean waves. Where sediments are particularly loose and wave energy high, the coast can retreat one to three or even tens of feet per year. Although the coastal uplands have been substantially reduced over the years, heath communities should survive along whatever coastal fringe remains.

Human populations pose the greatest immediate threats to these natural communities. Because such lands offer scenic ocean views and easily worked substrates, developers have hastened to buy up what acreage remains to convert it to home and building sites and parking lots. The bulldozer is, without doubt, the most serious and permanent destroyer of heathlands. For example, two small sites on eastern Long Island containing the rare bushy rockrose were found during recent searches by natural heritage staff members; but when the botanists returned soon after, one of the sites had been obliterated for development.

Heathlands also are highly sensitive to disturbance by recreational activities. Only one pass of an off-road vehicle can cause severe damage, and many coastal heathlands bear long-lasting



Ray Culter

Crowning a promontory on the Oregon coast, the Conservancy's Cascade Head Preserve bears a red-fescue grassland that is sustained through prescribed burning.

tire scars. Even constant foot traffic can quickly produce barren tracks.

Similarly, Pacific Coast grasslands owe their rarity to development or to changes brought about by the normal course of succession. But most seem to have fallen to the unbidden companions of human use—the aggressive followers of clearing and grazing: weeds. Sweet vernal grass from Europe, bluegrass from further east in North America, and a host of other exotic grasses and plants have invaded the headlands and coastal prairies.

One of the finest remaining native red fescue coastal grasslands in Oregon is under Conservancy stewardship. Crowning a spectacular promontory, Cascade Head, the prairie is now protected from building and further grazing. But the weeds are here, including the introduced tansy ragwort, and the Conservancy has begun an active campaign of managing the grassland to preserve its native character. Two years ago, Conservancy staff members from Portland began testing the same tool used to save heathlands—fire. All results are not yet in. However, after the first year of burning, the test plot at Cascade Head already appeared bluer with violets, a primary food source for the larvae of the nationally endangered and federally protected Oregon silverspot butterfly (*Speyeria zerene hippolyta*).

REALISTICALLY, we cannot expect regulations to halt all forms of inappropriate development. The "protection path" being taken by the Conservancy is the best way to preserve coastal heathlands and grasslands: it is essential, though expensive, to buy the most ecologically significant sites and create preserves. Human use of these sensitive communities then must be carefully controlled.

Even when the sites are protected, little can be done to stop natural coastal erosion except to promote the growth of native vegetation on dunes and bluffs. Meanwhile, two ongoing studies are seeking ways of arresting the ecological succession of heathlands. On Nantucket, Dr. Peter Dunwiddie of the Massachusetts Audubon Society is studying the use of fire to control shrub and tree invasion. Deborah McCartney, a botany graduate student at the University of Massachusetts, is conducting experiments on Martha's Vineyard for the Trustees of Reservations to compare the methods of burning and mowing as brush-control techniques. (Burning and sheep grazing have long been used to perpetuate the moors of Great Britain.)

Between East and West Coasts, common species and vanishing species differ. But in the red-fescue meadows and the coastal heathlands, the problem is similar: how do we preserve the parts of our natural heritage that themselves depend on change? In these successional habitats, to own land is not enough—the challenge of active stewardship must be met.

Although we have made great strides in protecting coastal wetlands and barrier islands, many other shoreline ecosystems are critically threatened. The Conservancy is literally racing the bulldozers to identify and preserve such sites.

An associate professor of botany at the University of Massachusetts, Amherst, **Dr. Paul Jeffrey Godfrey** has been studying coastal environments since 1968. He recently served on the U.S. Department of Interior's Coastal Barriers Study Group and specializes in coastal plant ecology. He has been supervising heathland studies on Martha's Vineyard.

Dr. Peter Alpert is an assistant professor of botany at the University of Massachusetts. Previously, he was with Stanford University where he researched coastal vegetation. This summer, he will be working with the Conservancy in the Pacific Northwest.

Louis Borie

The Great Lakes: Shorelines Old and New

by Louis Borie

AMERICA'S fourth coast lies far from any ocean. Made up of windswept dunes, sandy beaches, rocky bluffs, and ecologically rich wetlands, the Great Lakes shorelines enclose about a fifth of the world's fresh surface water. They also support some of the most scenic, ecologically diverse, and threatened habitats of any on the North American continent.

Unlike the U.S. seacoasts, which were formed as the oceans slowly rose, the Great Lakes coastlines were shaped as the level of the lakes slowly subsided following the last of the continental glaciers about 10,000 years ago. Gouged out by several advances of glacial ice during the Pleistocene, the basins of the Great Lakes were filled to capacity with the glacier's melting waters as the climate warmed and the ice sheets retreated to the north. In the succeeding years, the lakes drained through several different outlets, including one near Chicago that flowed to the Mississippi River. By approximately 3,000 years ago, the modern drainage pattern had been established, the St. Lawrence River had become the sole route for the Great Lakes to empty into the Atlantic, and the lakes had stabilized at their present level.

But as the waters of the Great Lakes subsided, they left a record of their presence. Sculpted sandstone cliffs along the southern shore of Lake Superior, wave-cut bluffs on northern Lake Huron, and towering sand dunes that rim Lake Michigan's eastern edge are all shoreline features created by past stages of the lakes. Broad plains that were once the bottom of the ancient lakes now contain productive wetland or, where the wetland has been drained, farmland.

Fortunately, some of the most scenic and ecologically significant coastal areas of the Great Lakes have been preserved by state governments, the federal government, and the government of Canada. Examples of these protected shoreline features are Indiana Dunes State Park and Indiana Dunes National Lakeshore at the foot of Lake

Michigan, Wilderness State Park at the tip of Michigan's Lower Peninsula, and Pt. Pelee Provincial Park on the northern shore of Lake Erie in Ontario. Lake Erie is also the site of Long Point, a 25-mile-long sandspit thrust out like an index finger into the lake. Encompassing extensive marshes and beaches, the 16,000-acre point was protected in 1978 through an innovative cooperative effort between the Long Point Company, the Canadian Wildlife Service, and The Nature Conservancy's International Program.

But some Great Lakes coastal lands haven't been as fortunate. In addition to providing a vast supply of fresh water, the Great Lakes region is home for 15 percent of the U.S. population and about half of Canada's people. As a result, residential and industrial development has affected mile after mile of Great Lakes shoreline, destroying or seriously altering important habitat for a host of plants and animals, some of which are endemic to the region. Second home development and resource extraction, particularly sand mining, threaten many more. Whether lakeside or seaside, shorelines are accessible and appealing for a variety of purposes.

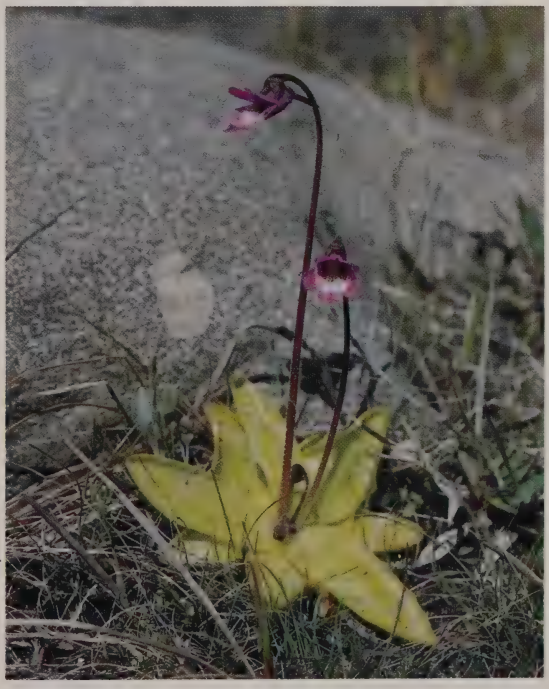
A NUMBER of important ecosystems and threatened plants and animals have been protected by The Nature Conservancy's land preservation program in the Great Lakes region. In Indiana, several examples of an uncommon ecosystem called "dune and swale" have been acquired by the Indiana Chapter. One of the largest of these, Shell Dune and Swale, isn't really an adjacent shoreline feature today—but it once was. The alternating low dunes and wet hollows of the preserve were formed at the southern tip of Lake Michigan some 4,000 years ago, during the final lowering of the lake. The lake's present level (about 25 feet lower) now leaves the dune and swale community more than a mile inland from the lake.

If anything, the distance of the preserve from Lake Michigan has only increased its scientific and educational value. Of the 10,000 acres of inland dune and swale that once occurred in northwest Indiana, the 50-acre sanctuary, donated to the Conservancy by Shell Oil Company in 1980, is one of the very few high quality examples of significant size. (The Conservancy also has assisted in protecting three other examples in Indiana of this globally threatened natural community at sites called Clark and Pine, Gibson Woods, and Ivanhoe Dune and Swale.)

Now included in Gibson Woods Nature Preserve and managed by the Lake County Park and Recreation Board, the Shell tract is significant for its geological as well as its ecological value. According to John Bacone, director of the Division of Nature Preserves under the Indiana Department of Natural Resources, it offers an unparalleled opportunity to study the dynamics of sedimentation of shoreline features in an undisturbed natural laboratory. In addition, Shell Dune and Swale was one of the sites for much of the geological research that established what Lake Michigan's major water levels were over the past 15,000 years.

Bacone also points out that the preserve's vegetation closely resembles that of presettlement

Sue Crispin



Sue Crispin

Rare flora of Michigan's Horseshoe Harbor Preserve, an exemplary "bedrock beach" on Lake Superior: heart-leaved arnica (at left) and butterwort (above).

Chris Maron

times. An untouched savanna community with an intact ground layer still exists at the preserve, making it one of the very few places this natural community can still be seen in the Midwest. Several dozen species listed as endangered or threatened in Indiana are found at Shell Dune and Swale, including small yellow lady's slipper, ragged fringed orchid, and paper birch.

WETLANDS are among the most threatened of any coastal ecosystem on the Great Lakes. Because they serve as nurseries for fish populations, nesting and breeding habitat for waterfowl, and natural flood control basins, wetlands are of incomparable ecological and economic value. But only a fraction of them remains, most having been drained for development or farming. On northern Lake Michigan, the Conservancy's Wisconsin Chapter has been acquiring land since 1976 to protect an unusual type of wetland that is almost nonexistent on the Great Lakes shorelines today.

The Mink River Estuary is an oddity—a wetland area under a tidal influence on the Great Lakes, where no tides exist. The "tides" in the estuary, which lies almost at the tip of Wisconsin's Door Peninsula, are created by a pattern of winds and atmospheric conditions that actually makes water flow up the Mink River 12 to 14 times

Indiana Field Office

Top: first light on Shell Dune and Swale, a Conservancy sanctuary in northwestern Indiana. The site's corrugated landscape records the retreat of glacial Lake Chicago. Small yellow lady's slippers (above) are among the hundreds of native vascular plants here.

a day. The constant mixing of the river's spring-fed, mineral-rich waters with the "soft" waters of Lake Michigan has produced a large, highly productive marsh at the mouth of the river. The marsh is an important nursery for smallmouth bass and northern pike as well as a nesting and breeding ground for waterfowl.

The 641 acres under Conservancy ownership protect not only portions of the Mink River's spring-fed headwaters but also parts of some 12 different natural communities, four of which are endangered or threatened in the state: northern sedge meadow, springs and spring runs, white cedar swamp, and Great Lakes beach. Two plant species that are candidates for federal listing—dune thistle and dwarf lake iris—also grow within the preserve's boundaries. Managed by the stewardship committee of the Wisconsin Chapter, the Mink River Estuary is one of only two estuaries in the Great Lakes proposed for inclusion in the National Estuarine Sanctuary System. The Conservancy hopes to safeguard some 1,200 acres of the estuary system through direct acquisition and conservation easement.

On northern Lake Huron, more than one-and-a-half miles of shoreline are protected by the Grass Bay Preserve, an ongoing project of the Conservancy's Michigan Chapter. Called "a haven of Great Lakes botany," Grass Bay is a museum of almost every ecosystem type found in the northern Great Lakes. The preserve's 400 acres encompass deciduous woods, pine forest, boreal forest, bog, wetland, low dunes, and beaches. According to Dave Mahan, field representative for the Conservancy's Michigan Field Office, the tremendous habitat diversity, periodic flooding from the lake, and the presence of both calcareous and acidic soils account for the more than 300 species of plants that have been identified at the preserve. Acquired with the assistance of the Federated Garden Clubs of Michigan, Grass Bay is used by students from the nearby University of Michigan Biological Station to study the flora of the northern Great Lakes.

"Bedrock beach" is the somewhat incongruous term used to describe the primary feature of the Michigan Chapter's Horseshoe Harbor Preserve. Located near the tip of upper Michigan's Keewenaw Peninsula, which juts northward into Lake Superior, Horseshoe Harbor embraces 200 acres of boreal forest and exposed bedrock that meet Lake Superior in magnificant low cliffs and more gradual "beaches" of sloping rock. One of the finest examples of bedrock beach community in the Midwest, the preserve provides habitat for several rare plants, including heart-leaved arnica, butterwort, and a western species of Indian paintbrush.

Wisconsin's Mink River, a fecund "tidal" estuary on northern Lake Michigan. Conservancy protection currently encompasses 12 distinct natural communities.

AS UNDISTURBED Great Lakes shorelines disappear or succumb to recreation-seeking Midwesterners, their natural communities and plant and animal species suffer. Probably the best example is the piping plover, a sparrow-sized shorebird once so common it was harvested in large numbers for food. Now the "piper," which nests on open, gravelly Great Lakes beaches, is almost entirely gone from the region. Fewer than 20 pairs remain in the Great Lakes, prompting the U.S. Fish and Wildlife Service to propose the bird for listing as endangered in that region and as threatened in the remainder of its range—the Atlantic Coast and the prairie pothole region of the Midwest.

According to the Fish and Wildlife Service, human disturbance, beach recreation, and development of beach areas have led to a decline in plover numbers in recent years. Ed Pike, a conservation officer for the Michigan Department of Natural Resources, has witnessed the decline firsthand. Pike has been monitoring the population of piping plovers in the Great Lakes region since 1974, when he banded his first plover in Wilderness

State Park, at the tip of Michigan's Lower Peninsula. He has now tagged dozens more of the rare birds. In recent years, his efforts have been aided by a special color-coded banding system devised in cooperation with the Fish and Wildlife Service. By attaching different combinations of colored bands to the adult plovers and by using a spotting scope, Pike can identify individual birds from a distance.

But in the past few years, Ed Pike has been sighting fewer and fewer plovers along the miles of suitable shoreline habitat he and several other volunteers check on Lakes Michigan, Superior, and Huron. In 1979, eight pairs of plovers—about one-third of the Great Lakes population—nested at Wilderness State Park alone. Last year, only two pairs nested successfully on the miles of sand and cobble Lake Michigan beach within the park.

"There's no question that human disturbance is a major factor in the plover's decline in the Great Lakes," says Pike. "But it's hard to say if that's the only reason why the shorebirds are disappearing. At this point, it's a mystery."

To address the problem of human disturbance, Pike and the Michigan Natural Features Inventory (a Conservancy-initiated heritage program) worked cooperatively last year on an innovative effort to protect the dwindling nests—mere scrapes in the sand lined with fingernail-sized pebbles—in Wilderness State Park. At the beginning of the breeding season in early May, Pike set up large enclosures around the nests using baling twine and posts supplied by the Conservancy's Michigan Field Office. Pike monitored the nests periodically and inspected the entire enclosure area. He found few footprints, indicating that fishermen and beach walkers had respected the restricted area.

The plovers? Of the two pairs nesting in enclosed areas, one pair produced offspring, which

Louis Borie

Louis Borie

Fewer than 20 pairs of piping plovers remain along the Great Lakes. Top: bare beginnings—clutch of eggs in a lakeshore nest scrape. Above: adult on the move. Opposite: Michigan scientists attach identifying leg bands to chicks (top) and build simple enclosures around nests to ward off intruders (at right).

Louis Borie

Louis Borie

Pike banded. The clutch of four eggs produced by the other pair disappeared between two of Pike's visits, apparently the work of a raccoon or other predator. The monitoring of the Great Lakes population of piping plovers continues; but some people feel that unless the lakes' plovers start to interbreed with the prairie pothole population, "pipers" in the Great Lakes may be a species of the past.

THE SHORELINES of the Great Lakes are a resource incomparable in diversity, scale, and cultural significance. For thousands of years, the people of the region—from native Americans to European explorers to early settlers—have used these coastlines for travel, for homes, and for vacation sites. In the future, pressures on the shorelines will be even greater. However, through the public efforts of state and federal agencies and the private efforts of organizations like The Nature Conservancy, important Great Lakes natural areas are being set aside for their scenic, scientific, and recreational value—and for the species that depend on these wild places for survival.

An occasional free-lance nature writer and photographer, **Louis Borie** is also director of the Vermont Natural Resources Council. He was formerly executive director of the Little Traverse Conservancy in northern Michigan.

Birds of the Beach

by Wayne Klockner

"For within this special belt there is a very special line which not in all Earth's history was ever twice the same, a line which has broken into a billion new curves while these words are being read. It is the edge of the wave which the sanderling follows. . . ."

—William Leon Dawson

ORNITHOLOGISTS KNOW that birds are abundant and diverse on the borderline between natural communities, where species have the best of both worlds. In these border areas or ecotones there is an inherent biological richness, an ecological phenomenon called the "edge effect." Perhaps the greatest "edge" is the coast itself—and what a fine place to find birds.

Our nation's shoreline is distinguished by a wealth of sandy beaches. On the geologically young West Coast, miles of sand beach skirt the bases of hills, only occasionally interrupted by rocky headlands. The older East Coast with its history of glacial influences offers small, scattered beaches in New England and vast coastal plain beaches and barrier islands farther south (on the Atlantic and the Gulf of Mexico). The sterile appearance of the sand beach belies the intense biological activity it often supports. Here, fertile ocean currents and upwellings meet the nutrient-laden rivers flowing from the interior, creating sustenance for an array of plants and animals—birds prominent among them.

Within the framework of the seasons, the shores of America host a characteristic succession of bird species. For many, the "spring" migration along both coasts actually begins in February. Waterfowl start their push northward, timing the journey to arrive at nesting grounds in the north with the spring thaw. At the shore, the most conspicuous of these early northbound migrants are the brant and snow geese—which fly in skeins, often quite low, over the dunes or breakers. But spring migration reaches its highest pitch later in

Tom Mangelsen

Glenn Van Nimwegen

Top: marbled godwit hunts the "swash" zone. Above: willet at dawn. Both shorebirds are named for their calls ("god-wit" and "will-will-willet" respectively).

April and May, when the beaches are alive with shorebirds, including plovers, sandpipers, and turnstones. These birds are on a long-distance journey from wintering areas in southern South America to nesting areas on the Arctic tundra. At the end of the trip, they have a scant four weeks to raise their young.

On the East Coast, shorebirds reach a peak in numbers and diversity during the spring (or highest) tides in May. During these flood tides, horseshoe crabs spawn by the thousands on beaches like those edging the Delaware and New Jersey shores of Delaware Bay. This intense spawning activity produces billions of eggs, an energy-rich food source for migrant shorebirds. Surveys reveal that significant portions of the American populations of such species as the red knot depend upon horseshoe crab spawning for a critical refueling stop. In fact, many individual birds use the same beaches year after year for only a matter of days each time, and a single stretch of sand can

Frans Lanting

Age-old shore sport: sanderlings (starling-sized sandpipers) race the tide at Monterey Bay, California.

become very important to a multitude of species. Such a beach is a remarkable sight—thousands of knots, dunlin, and smaller sandpipers (or "peeps") feasting shoulder to shoulder on the temporarily abundant eggs.

Of course, horseshoe crab eggs are not the only beach commodity exploited by shorebirds. Whimbrels, willets, marbled godwits, and black-bellied plovers hunt the beach's swash zone (which lies between high and low tide lines) for sand-dwelling polychaete worms, mole crabs, and other marine invertebrates. In fact, the beach's food resources are partitioned by shorebird morphology: bill length and even leg length dictate the area of the beach and the type of organism upon which a particular shorebird species will feed.

DURING THE SUMMER months, seacoasts lack the earlier diversity of birds, and nesting species predominate. The beach can be an inhospitable place to build a home: nesting birds must endure temperature extremes, avian and mammalian predators, and storms that bring high winds and flooding tides. Given the fact that these species are exposed on an open expanse of sand, a key adaptation for beach nesters is camouflage coloration of incubating adults and their eggs. Lodged within a slight nest scrape with little or no embellishments, the pale, spotted eggs nearly disappear and may be easily mistaken for bits of shell, grass, or gravel.

Two beach-nesting species have received national attention recently owing to a serious decline in their numbers: the least tern of both coasts and the piping plover of the East. (Interestingly, both species have interior nesting populations as well. See page 17 for information on piping plovers of the Great Lakes region.) Least terns nest in small colonies on open sand, frequently at the highest point of the beach before dune vegetation begins. Here they raise one or two young. As is true with all beach-nesting terns and shorebirds, least terns

Frans Lanting

Glenn Van Nimwegen

Frans Lanting

Birds of the beach. Top: semi-palmated sandpipers feed in the shallows of Delaware Bay. At right: whimbrel wading. Above: flotilla of snow geese, some of the earliest northbound migrants on both coasts.

hatch chicks capable of independent activity from birth. Covered with protectively colored down, the newborns are able to move about and take refuge in grass clumps or find other shelter. These adaptations enable the chicks to survive the frequent absence of their parents, who forage for small fish at some distance from the colony.

Piping plovers nest in the same habitat, often near least tern colonies. The plovers are solitary nesters, with each pair claiming a stretch of beach as its nesting territory. Like the terns, they frequently forage for food away from the nest territory, but the chicks are so well camouflaged that they can remain in the nest without undue danger. The piping plover has a western counterpart, the snowy plover, which nests on open sand on West Coast and Gulf Coast beaches.

The barrier beaches of the Atlantic support other nesting terns, including common tern, royal tern, and black skimmers. Gathering in colonies is *their* adaptation to the rigors of beach life. Colonial nesting offers the birds an extra measure of safety from predators: their very numbers increase both their vigilance and their mobbing capability while decreasing the risk to any individual nest. Colonies are often established near inlets or bays where food for young is abundant, and their structures appear to be determined by the nature of each species' food source. For example, royal terns, which prey upon schools of fish far offshore (an unpredictable food source), nest in large, dense colonies, exhibiting a flocking habit that aids them in locating prey. In contrast, black skimmers, which forage individually near the beach or in tide pools and bays near home (where fish are easily found), tend to nest in small, loose colonies. Common terns hunt for food closer in than royal terns but farther away than black skimmers—and their colonies are intermediate in density.

FALL MIGRATION begins on the coasts before the summer ends. The first arrivals at the beach are adult shorebirds who have raised their broods during the brief Arctic summer. The juveniles show up almost a month later, only to find the older generation defending feeding territories on the choicest beaches!

Onshore winds of fall storms may deposit a number of other species on the beach, including golden plovers and Hudsonian godwits. Although these birds migrate northward through the continent's interior, they make the return journey south over the ocean. Autumn is also the time to observe migrant raptors, especially on the East

Bruce Sorrie

Least tern—increasingly rare on both coasts—spreading "brood feathers" over its seaside nest. The chicks are born with camouflage coloring and the ability to move on their own.

Glenn Van Nimwegen

A throng of dunlin over Chincoteague National Wildlife Refuge, a coastal wetland on the Delmarva Peninsula.

Coast, where northwest winds concentrate hawks and falcons along the shoreline. On a good "flight day" in September or October, one can see species such as sharp-shinned hawk and northern harrier moving in large numbers. And there are falcons in force: peregrines, merlins, and kestrels that follow the shoreline south, preying upon the hordes of songbirds and shorebirds that take the same route.

With the onset of winter weather, the northern beaches of both coasts become havens for the sanderling, one of the hardiest of shorebirds. And after winter storms, numerous gulls—including herring, great black-backed, and rarer species from the far North (Iceland and glaucous gulls)—patrol these beaches for storm-tossed food items. A bonus for the winter bird-watcher in the Northeast is the occasional visit of a snowy owl or snow bunting: tundra dwellers who find at the beach an environment similar to their summer habitat.

On the nation's southern beaches, milder climates enable a greater number of bird species to winter by the sea. The coast of southern California hosts a variety of wintering shorebirds—marbled godwit, dunlin, and western sandpiper among them. And by February, of course, the cycle begins again with spring migration and its pageant of visitors.

MILLIONS OF BIRDS flock to our shorelines each year, marking the changes of season as clearly as the shifting sun. Their visits seem inevitable. Sadly, they are not. Many of the species mentioned in this overview require pristine beaches, especially for nesting, and such habitats are harder and harder to find. With more than half of all Americans living just a short ride from the sea, the conflict between recreational development and shoreline conservation continues to intensify—placing ever greater pressures on what little natural beach remains. Knowing that the loss of wild shores means the loss of species, we must recognize the warnings we're receiving (such as the serious declines suffered by the least tern and the piping plover) and respond quickly.

The scientists of Conservancy-designed state natural heritage programs in coastal states are hard at work identifying critical shoreline habitats. If we succeed in protecting a good portion of these properties, a long list of species—including waterfowl, shorebirds, and raptors—will benefit, as will every new generation that walks the beach to see the seasons change.

Wayne Klockner, an avid birder and fly fisherman, is assistant director of the Conservancy's Maryland/Delaware Field Office.

ECOLOGY FORUM

No. 55
by Larry E. Morse
Staff Botanist

SHORELINES IN MOTION: OUR COASTAL BARRIERS

The sandy beaches, islands, and peninsulas of the U.S. Atlantic and Gulf coasts are among the most dynamic natural landscapes on Earth. Their three primary landforms—beach, dune, and marsh—are shaped by winds, waves, and tides. These forces effect change on a scale that ranges from feet to miles, in periods that range from minutes to millennia.

Collectively called *coastal barriers,* these islands and peninsulas are generally composed of unconsolidated sand flanked by water or wetlands. One side faces the open ocean and the other borders a shallow lagoon, bay, sound, or marsh. Unlike bedrock, this loose sand is held in place only by gravity and vegetation.

The typical coastal barrier system is continually undergoing three major short-term geological processes: 1) movement of sand within the dune zone, affecting the barrier's internal structure; 2) movement of sand from beach to dune, and dune to back-island marsh, resulting in a slow net drift of the shore inland; and 3) movement of sand along the shore, causing a loss of sand in some areas, and fresh accumulation in others, a process that changes the shape or location of the island or peninsula.

On a day-to-day basis, wind and waves are the most obvious factors affecting the shape and location of coastal barrier beaches. Along the shore, each ocean wave rearranges the sand a little. This may appear to be a simple back-and-forth motion, but careful observation shows that the whole beach is usually creeping slowly sideways along the shore, with each back-and-forth cycle of the waves leaving the surface sand in a slightly different place.

The dune zone, found behind the beaches of most coastal barriers, is dramatic evidence of the wind's power to move sand. Narrow barriers have a single dune line, if any, while broader coastal barriers may have well-differentiated foredune, interdune, and backdune zones. The general shape and location of a coastal barrier's dunes are usually determined by the direction and strength of the prevailing fair-weather winds, active when the sand is dry. As long as there's a fair breeze—over ten miles per hour—billions of sand grains are being blown about, moving a few inches at a time. (However, where grass grows, a strong wind is needed to move the sand.) In high winds over bare beach or dune, a dense cloud of drifting sand rises a foot or so above the surface. These faster-moving sand grains can travel many feet before they fall.

Ordinary mainland vegetation seldom succeeds in colonizing this landscape of shifting sands, with its exposure to salt spray, high winds, and overwash. But a number of plant species are well adapted to these conditions. Although flora has little noticeable effect on the form of the landscape in most mainland habitats, the presence or absence of plant life dramatically affects the dynamics of a dune field. Even a few blades of grass can begin a new dunelet.

Deep-rooted plants such as beach grass (*Ammophila breviligulata*) or sea oats (*Uniola paniculata*) are among the few species capable of surviving the wind and salt spray of the foredunes, the first dune line nearest the beach. Indeed, these species promote dune formation and thrive on the accumulating sand, growing upward and forming fresh roots and rhizomes as fast as the sand is deposited. Establishment of these grasses from seed is very difficult, but most spread extensively by rhizomes once the plant is growing. Because the underground structures of the plants can be damaged by a single footstep—or, worse yet, the tires of an off-road vehicle—dunes are often posted with "keep off" signs. Elevated walkways are a solution in areas where large numbers of people have to cross a dune zone.

Further inland, away from storm waves and the most intense salt spray, a greater variety of plants helps stabilize the sand. (Where dense vegetation has taken hold on a dune, shrub areas and even

forests can develop.) Yet the evidence of rapid changes in the landscape is still obvious. Here and there in the dune zone—especially downwind from bushes, dune crests, or other obstructions—are sloping, smoothly contoured, snowdrift-like piles of freshly deposited sand, dropped grain by grain as wind gusts were momentarily slowed by the obstruction. It is this mechanism of sand accumulation that leads managers of coastal barriers to erect snow fences or other low structures where they want dunes to grow.

In other areas among the dunes, steep slopes with collapsing tops indicate places where sand is being eroded away and transported by the wind. Sometimes large hollows of bare sand, perhaps 20 feet deep and 200 across, form where a gap in the dunes focuses the wind. These "blowouts" can deepen until more stable sand near the local water table is reached. In yet other spots, rapidly accumulating sand can build a steep, fresh dune rising above its surroundings.

There are cases in which these big dunes, 50 feet or more high and maybe a quarter-mile long, advance as a unit when storm winds blow sand over the top from the upwind face and drop it on the downwind slope, covering anything in its path. These "walking dunes" can bury an entire forest; the treetops rising from the sand look like mere bushes. Then, as the dune moves on, the dead trunks and branches are left in a ghost forest.

Hurricanes, northeasters, and other major storms are the primary natural forces changing the barrier island landscape—rearranging the shore, shifting the dunes, adding sand to the marshes, and occasionally creating openings in the forests. Few shore visitors experience such storms firsthand, but their effects are evident weeks, months, and years later. Most big storms generate immense waves that wash high on the beach and often spread far inland. Storm waves regularly cross any low areas in the dune zone, spilling into the marshland or open water beyond. As they cross the dunes and marshes, the energy of these huge waves is considerably depleted. In this fashion, coastal barriers help protect nearby inland areas from storm damage.

Storm waves are loaded with churned-up sand, sea salt, and organic matter, which they leave behind as "overwash fans" in the dune zone and marsh areas. The freshly deposited sand is eventually worked into the surrounding dunes or marsh, or is vegetated in place to create "barrier flats." Within weeks of a storm, these flat, sandy places can be dense with new plants.

Like ordinary waves, storm waves also tend to strike a shore obliquely, resulting in a net sideways transport of beach sand that removes it from a particular portion of the shore and deposits it elsewhere. This "longshore drift" is a major shaper of our coasts, for it lengthens the barrier beaches and smooths their contours.

If a surge of storm-driven water is focused into a low area of a coastal barrier, the currents generated can cut a peninsula or island in two, eroding the sand away within hours to leave an inlet or "pass" behind. Although these gaps in the barrier sometimes persist for centuries, they often close within weeks.

A mature coastal barrier system contains all of these landscape elements: active and stabilized dunes; grasses, shrubs, and perhaps forests; blowouts and fresh sand deposits; overwash fans and temporary inlets. These features do not stay permanently in place: over years and centuries, they shift about from one part of the landscape to another. Yet, in a given barrier system, the overall mix of features stays about the same.

A much longer-term aspect of coastal barrier dynamics is imperceptible to the casual visitor but distressingly obvious to residents of the Atlantic or Gulf Coast. The water level itself can change. Local uplift or subsidence of the land can alter the apparent water level, usually over decades or centuries. On an even broader scale, over thousands of years, the actual worldwide level of the oceans—sea level—can itself rise or fall. In particular, the vast continental glaciers of the various Pleistocene ice ages held so much water that sea level then dropped hundreds of feet, and most of the continent's Atlantic and Gulf beaches were scores of miles farther out. Melting of the most recent continental glacier during the past 20,000 years has returned sea level to its present-day mark and moved the shore—with its beaches, dunes, and barrier islands—inland as well. The process, although now slow, is still continuing.

For long-term conservation of coastal barrier systems, planning must be done on a scale of tens of miles so that even a hurricane's effects can be considered a normal part of a preserve's history. Protected areas must be large enough that storms and other natural forces will primarily rearrange the land *within* the preserve boundary, not move it elsewhere. Significant development of even a few small parts will inevitably lead to pressures to "freeze the map" and artificially halt shoreline changes on the barrier as a whole. The ideal unit of design for a coastal barrier beach preserve would be the entire island or peninsula itself. Where possible, protection should be sought for a whole chain of coastal islands—interconnected by inlets and tidal flats—as at the Conservancy's Virginia Coast Reserve, a 14-island sanctuary that reshapes itself with each passing storm.

NEW PROJECTS

CALIFORNIA

Coachella Valley—Addition—(Riverside County). In its effort to establish a vast preserve assemblage in this desert oasis near Palm Springs, the Conservancy has purchased another 160 acres. Coachella features one of the state's largest groves of increasingly scarce desert fan palms (*Washingtonia filifera*) as well as sand dune habitat for the nationally threatened Coachella Valley fringe-toed lizard (*Uma inornata*). Charted for protection through the National Wetlands Conservation Project and the Katharine Ordway Endangered Species Conservation Program, the 8,712-acre sanctuary is managed by the California Field Office.

Consumnes River—Addition—(Sacramento County). A 240-acre purchase enlarges this sanctuary of native riparian woodland, an ecosystem that's been reduced to an estimated one-tenth of one percent of its original distribution in the state. The valley oak community bears California's largest group of old and young trees—a mix indicating reproductive vitality. The California Field Office manages the 411-acre preserve.

Creosote Clone (San Bernardino County). It looks like any other stand of creosote bushes (*Larrea tridentata*), but this may be the grand-daddy of them all. Issuing from a single seed that took hold an estimated 11,700 years ago, the ring of genetically identical plants (or clones) formed as the original seedling's branches grew roots and those roots, in turn, grew their own branches—creating a widening hoop of living creosote as the center died off. "King Clone" thrives on a 17-acre Mojave Desert site purchased by the Conservancy with the help of several other groups, including the California Garden Clubs and the California Native Plant Society. Dr. Frank C. Vasek of the University of California at Riverside has called it the world's oldest known living organism. Research on the preserve, which is being transferred to the university for management, may shed light on how the Mojave Desert evolved.

ILLINOIS

Clarksville Island—Addition—(Calhoun County). This Mississippi River island attracts wintering bald eagles, summering great blue herons and great egrets (the latter is endangered in the state), and nesting birds of more than 100 species. Situated below a river lock and dam, the area has open water all winter—a boon for waterfowl and eagles alike. The Conservancy's recent 42-acre purchase on an adjacent island brings the entire sanctuary to 860 acres. The Clarksville Island complex lies close to Missouri and is a joint project of the Illinois and Missouri Chapters, which manage the addition.

IOWA

Fern Ridge (Additions). In northeastern Iowa, just west of the Mississippi River, sheer limestone bluffs rise 60 feet above a small creek. Cold air seeps on portions of the area's north-facing slopes foster a flora characteristic of northern climes. Two of the site's plants, dwarf scouring-rush and limestone oak fern, are threatened in the state. The slopes also host a nationally endangered snail, once believed extinct. Sixty-nine acres in two purchased tracts bring the Iowa Chapter preserve, a project of the Conservancy's Katharine Ordway Endangered Species Conservation Program, to 221 acres.

MARYLAND

Nassawango Creek—Addition—(Worcester County). A 95-acre purchase extends Conservancy holdings along the 15-mile corridor of Nassawango Creek, a tributary of the blackwater Pocomoke River on Maryland's Eastern Shore. Now spanning 2,461 acres, the sanctuary encompasses a bald cypress/sweet gum swamp that hosts dozens of rare species and natural communities. The Conservancy's Nassawango Creek Stewardship Committee manages the preserve.

MINNESOTA

Black Dog Nature Preserve—Additions—(Dakota County). Calcareous fens and mesic black-soil prairies are among the rarest natural communities in Minnesota: the fens claim less than 700 acres in the state, the prairie type covers barely 500. But this site in the Minnesota River Valley has both. What's more, three plant species listed as threatened in Minnesota flourish in an undisturbed fen here: beak rush (*Rhynchospora capillacea*), nut rush (*Scleria verticillata*), and a valerian (*Valeriana edulis*). With the recent purchase

Gary Randorf

Boreal Heritage Preserve

Outside Alaska, America's largest sanctuary is New York State's six-million-acre Adirondack Park: a land of dense forests, thousands of glacial lakes and ponds, and some 30,000 miles of mountain watercourses. During the past 14 years, the Adirondack Conservancy Committee has helped protect more than 150 square miles here, 40 percent of it in cooperation with the state.

Within the park, west of Saranac Lake, lie more than 200,000 acres of boreal wetlands: the most extensive, least-disturbed collection of such communities within the state and, quite possibly, in the eastern U.S. At the core of this peatland phenomenon is a projected 75,000-acre Conservancy preserve—with two nationally significant bog communities, one of the largest privately owned tracts of "old growth" forest in the East, and vast stretches of critical wildlife habitat.

In the late '70s, the Adirondack Conservancy Committee gained conservation easements on 48,500 acres here. New developments include the purchase of 3,065 acres in two parcels, the gaining of an easement on an additional 2,821, and negotiations for acquisition of a 1,200-acre tract that is prime habitat for the spruce grouse (considered a species of special concern by the New York Department of Environmental Conservation). The recent acquisitions include Spring Pond Bog, a superlative patterned peatland at the very heart of the area. With 54,386 acres under its care, the Conservancy is well on its way towards its conservation goal at Boreal Heritage Preserve, a project of the Goodhill Foundation-funded National Critical Areas Conservation Program.

of two tracts totaling 50 acres, the Conservancy has now protected 99 acres through the Minnesota Chapter's Critical Areas Campaign. The land is managed by the Minnesota Department of Natural Resources within its Black Dog Scientific and Natural Area.

Lac Qui Parle Prairie—Additions—(Lac Qui Parle County). According to legend, an old Indian claimed the lake here spoke to him at night. Dubbed "Lake Speaks" by the Dakota, Lac Qui Parle (a widening in the Minnesota River) got its current name in later years from French explorers. Purchased through the National Wetlands Conservation Project, 401 acres in two tracts safeguard the area's critical waterfowl nesting habitat. The preserve, now 964 acres all told, also features a mesic prairie and numerous potholes. With adjacent state land, it provides a full continuum of habitats—from upland prairie to "lake" shore—on this rocky terrace. The lands will be included in the Minnesota Department of Natural Resources' Lac Qui Parle Wildlife Management Area.

MISSOURI

Caruthersville Heron Rookery, Pemiscot County. Here in the Mississippi River lowlands, an artificial lake (with open water year-round) hosts Missouri's most significant heronry. Thousands of birds of numerous species throng to the site, including little blue herons, snowy egrets, black-crowned night herons, and great egrets—all of which are endangered or critically imperilled in the state. Caruthersville is also the only known site in Missouri for nesting anhingas. The Conservancy's purchase of 43 acres safeguards the entire lake and its willow-line border. The preserve, a prime site for bird watching, is managed by the Missouri Chapter.

MONTANA

Pine Butte Swamp—Addition—(Teton County). With a recent 1,362-acre purchase, the Conservancy has protected a sum of 13,807 acres here on the Rocky Mountain front. The sanctuary takes in foothill prairie, limber-pine savanna, spruce/fir forest, mountain streams, aspen/willow groves, glacial ponds, and spring-fed swamp. Its wetlands are critical seasonal habitat for the grizzly bear, a species threatened throughout its range. The Big Sky (Montana/Wyoming) Field Office manages the refuge, which lies along the Teton River.

NEW JERSEY

Hirst Pond—Addition—(Atlantic County). A 60-acre addition (a partial gift of Aansley Enterprises, Inc.) brings Conservancy protection to 85 percent of this vernal pond—an uncommon community on the mid-Atlantic coastal plain. Because it fills with rainwater in spring and dries out by summer, the pond supports an extraordinary flora—including eight rare species, two of which are under consideration for federal protection (Hirst's panic grass and Boykins' lobelia). The pine barrens tree frog finds habitat here as well. A component of the Katharine Ordway Endangered Species Conservation Program, the 80-acre preserve is managed by the Pennsylvania/New Jersey Field Office.

OHIO

Edge of Appalachia Preserve System—Additions—(Adams County). Owned and managed in part by the Conservancy, in part by the Cincinnati Museum of Natural History, this vast and diverse system presently encompasses eight contiguous sanctuaries along the corridor of Ohio Brush Creek. The Conservancy has recently acquired additions for two of these preserves: 30 acres for Lynx Prairie and 164 for Abner Hollow. Lynx Prairie is significant for its series of uncommon grasslands (relicts of a time when the continent's interior was far drier), and Abner Hollow for its mosaic of woodland and prairie openings. Embracing almost 6,000 acres in all, Edge of Appalachia harbors several uncommon plant communities and a multitude of rare species.

SOUTH CAROLINA

Savannah River Bluffs (Aiken County). Coves and ravines among these river bluffs support a one-of-a-kind refuge for rare flora in the state. Relict trillium (*Trillium reliquum*), bottlebrush buckeye (*Aesculus parviflora*), and six other plants considered rare or endangered by the South Carolina Heritage Trust occur here. With the purchase of two tracts totaling 105 acres and an easement on an additional five, the South Carolina Chapter has made an excellent start in the area, which is also known for its historic Indian fishing weirs and archeological sites. Monies obtained through the state legislature (from the new South Carolina Heritage Land Trust Fund) will assist with protection of the site, which is currently managed by the South Carolina Field Office.

TEXAS

Tres Corrales—Addition—(Hidalgo County). An "island" of wild country surrounded by intensive agriculture, Tre Corrales boasts one of the state's two largest Tamaulipan subtropical woodlands, an endangered and diminishing native plant community. In the fertile soils of the Rio Grande

Valley, the shrubs that make up this forest have attained tree height. Rare animals include the Rio Grande siren (an aquatic salamander endangered throughout its range), Texas tortoise (state-listed as threatened), and three other reptiles endangered in Texas. Two cats federally classified as endangered have been sighted here: ocelot and jaguarondi. The purchase of 218 acres brings protected acreage to 568. Currently managed by the Texas Field Office, the preserve ultimately will be conveyed to the U.S. Fish and Wildlife Service.

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Modern housekeeping cottages overlooking a mountain creek are available for rental year-round at the Conservancy's Mile Hi Ranch. Located 90 miles southeast of Tucson in the Huachuca Mountains, the Mile Hi stretches across the mouth of Ramsey Canyon, one of the most lovely and biologically diverse canyons in southern Arizona.

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The Nature Conservancy
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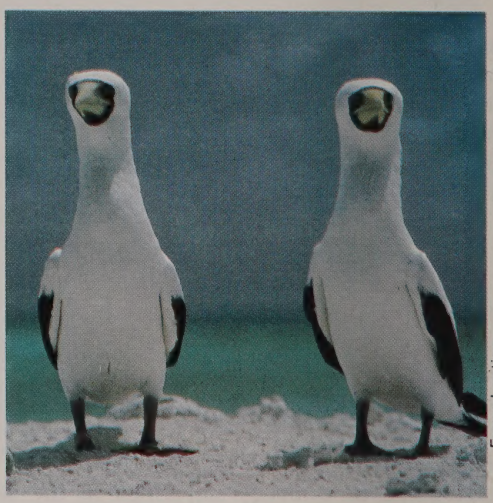
On the weekend of October 18-20, 1985, a nature and wildlife photography workshop will be held at the Conservancy's Virginia Coast Reserve. Both amateur and professional photographers are invited to learn techniques of nature photography through lectures, slide shows, and field trips to the barrier islands that make up the Reserve. For more information about this workshop and other fall natural history programs, write: John Hall, Virginia Coast Reserve, Brownsville, Nassawadox, Virginia 23413; or call (804) 442-3049.



Frans Lanting

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